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| Re: | | |
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| | Application of: | Berman, Michael J. |
| | Serial No.: | 09/553,140 |
| | Filed: | April 20, 2000 |
| | For: | Determination of Film Thickness During Chemical Mechanical Polishing |
| | Group Art Unit: | 2623 |
| | Examiner: | Vikkram Bali |
| | Our Docket No.: | 99-230(1003-0547) |

REPLY TO EXAMINER'S ANSWER

Sir:

This is a Reply Brief submitted in response to the Examiner's Answer mailed on June 16, 2004. Three copies of the Reply Brief are submitted herewith.

**Discussion**

*Discussion re Claim 1*

1. Claim 1

As stated in the Brief on Appeal (the "Brief"), claim 1 recites that an image is taken of a substrate using high speed imaging while the substrate is being polished. The image is compared to stored image patterns and, when a corresponding stored image pattern is found, the acquired image is converted to a layer thickness measurement.

The Examiner appears to have abandoned his previous position, and now offers three new grounds in support of his rejection of claim 1. The Examiner now contends that CCD imaging is inherently high speed, that imaging during a rinse activity in a CMP process anticipates imaging during a polishing activity in a CMP process and that O'Boyle suggests moving its optical enclosure to areas of a CMP machine other than a rinse tank. All of the Examiner's new grounds for rejection are wrong.

2. New Grounds Regarding CCD Imaging.

A. Inherency is a New Ground for Rejection.

In the Office Action dated October 6, 2003 (the "Second Office Action"), the Examiner simply mischaracterized O'Boyle as teaching "a high speed imaging device". (Second Office Action at page 2). For the first time in the Answer, the Examiner now appears to claim that CCD imaging is *inherently* high speed imaging stating that "[CCD] images are considered to be the high speed imaging as called in the specification by the applicant." (Answer at page 3). The Examiner did not indicate that his new position was

an alternative reading of O'Boyle. Accordingly, it appears the new ground for rejection was intended to supplant the prior ground for rejection.

Our response to this new ground of rejection is set forth below.

B. CCD Imaging Is Not Inherently High Speed Imaging

The Examiner's inherency based argument must fail. MPEP § 2112 requires the Examiner to provide rationale or evidence tending to show inherency. To establish inherency, the extrinsic evidence must show that the missing descriptive matter is "necessarily present". (MPEP § 2112). Accordingly, the Examiner has alleged that all CCD imaging is *necessarily* high speed.

However, CCD imaging is not inherently high speed. It is well known, even to lay persons, that a significant advantage of the use of CCD arrays at the focal plane of an optical device is to allow for long exposure times. The Board need only consider the well publicized uses of the Hubble Telescope, which for many operations relies upon extremely long exposures while dwelling (pointing) at a discreet point in space. (See e.g. information available at http://www.nasa.gov/ et seq.). Therefore, all CCD imaging is *not necessarily* high speed imaging.

Moreover, the Examiner has failed to provide evidence or rationale tending to show inherency as required by MPEP § 2112. For these reasons, O'Boyle does not disclose high speed imaging as claimed. Accordingly, in addition to the reasons set forth in the Brief, claim 1 is patentable over the prior art for at least the reason set forth above.

3. New Grounds Regarding the Method of O'Boyle

A. Alleging O'Boyle Images While Polishing is a New Ground

The Examiner made no allegation in the Second Office Action (or the Office Action dated April 21, 2003) that O'Boyle taught a method of determining layer thickness while polishing. (See e.g. Second Office Action at page 2). In the Answer, the Examiner now claims that O'Boyle teaches obtaining measurements while polishing. (Answer at page 4).

B. O'Boyle Does Not Image While Polishing

The new rejection is without merit. O'Boyle only specifies that measurements are taken during the CMP *process*. (See e.g. O'Boyle at column 1, lines 55-67). However, the CMP process includes many activities that are not "polishing". In particular, the CMP process is typically done on one integrated machine. The CMP process includes the steps of loading a wafer onto a chuck, polishing the wafer, rinsing the wafer, cleaning the wafer, drying the wafer, unloading the wafer from the chuck and measuring the wafer. (See e.g. U.S. Patent No. 6,319,093 at column 1, lines 32-35). All of these steps have a variety of activities that are associated with the various steps. Thus, the taking of measurements during a CMP process does not necessarily mean that the measurements are taken during the activity of polishing.

In fact, O'Boyle is clearly directed to obtaining thickness measurements in a rinse tank of the CMP assembly where polishing does not take place. Specifically, O'Boyle clearly states and shows that the optics enclosure 14 is in the rinse tank 16. (See O'Boyle at FIG. 1, column 2, lines 64-66). Thus, by stopping any polishing activity and "by

simply moving the wafer to the rinse area, it is possible to measure the film thickness at an intermediate point during the polish operation..." (Id. at column 5, lines 8-10). Accordingly, even if the measurement of O'Boyle is taken during a polishing step of the polishing process, the measurement is done during a rinse activity.

In further response to the Brief, the Examiner points to column 3, lines 61-67 of O'Boyle in support of the new allegation that O'Boyle suggests taking measurements on or at "any other applicable process equipment..." (Answer at page 3). The actual sentence of O'Boyle, however, is that the measurement can be made "while [the wafer] remains chucked in the polish tool, or other applicable process equipment..." (O'Boyle at column 3, lines 62-64). Therefore, O'Boyle merely states that in taking a measurement, the wafer can remain chucked in whatever piece of equipment it was originally chucked in during the CMP process. In other words, to obtain a measurement, there is no need to remove the wafer from a chuck, no matter what piece of equipment the chuck is a part of. Thus, the phrase "other applicable process equipment" does not support the Examiner's allegation that O'Boyle suggests moving the optics enclosure to a location other than the rinse tank.

Claim 1 recites that the image is acquired during the chemical-mechanical *polishing* of a substrate. Thus, claim 1 clearly recites that the image is acquired during the activity of polishing a substrate in a CMP Process. Taking an image of a wafer during the activity of *rinsing* the wafer in the clear water of a rinse tank during a CMP process *is not the same* as taking an image of a substrate during the activity of *polishing* the substrate with a polishing pad during a CMP process. Therefore, O/Boyle does not teach the claimed step of acquiring an image during polishing of a substrate.

4. Conclusion

Therefore, claim 1 is patentable over the prior art as discussed in the Brief and for at least the reasons set forth above.

*Discussion re Claim 7*

1. Claim 7

Claim 7 recites a step wherein pixels of a high speed image are converted into layer thickness. The Examiner has apparently abandoned his previous basis for rejection and for the first time in the Answer appears to be alleging that because a CCD image is made of pixels, and because it is alleged that O'Boyle teaches conversion of images, then O'Boyle necessarily teaches conversion of pixels. The new allegation fails for several reasons.

2. The Discussion of Claim 1 Applies to Claim 7.

In the Answer, the Examiner applied the new rejections discussed above with respect to claim 1 to claim 7. Claim 7 depends from claim 1 and includes all of the limitations of claim 1. Therefore, for at least the same reasons set forth above with respect to claim 1, the Examiner's new rejections of claim 7 must fail.

3. A Prima Facie Case of Obviousness Has Not Been Alleged.

The Examiner originally relied upon "the same reasons set forth for claims 17-21" in rejecting claim 7. (Second Office Action at page 4). For claims 17-21, the Examiner

alleged that "Bibby further teaches: the light source with a spectrum between 200 and 1000 nm (see col. 6, lines 13-17) and the thickness measurements using the pixel conversion (see col. 7, lines 20-27) as claimed". (Id. at page 4). Thus, the Examiner relied upon Bibby for teaching pixel conversion. However, in the Answer the Examiner now states that Bibby is relied upon only for showing "that the image is the make up of a number of pixels". (Answer at page 5).

Accepting arguendo the Examiner's basis for his earlier reliance upon Bibby, then notwithstanding the above quoted portion of the Second Office Action must be read as not alleging that Bibby teaches or suggests pixel conversion. However, the Second Office Action *does not allege* that O'Boyle teaches pixel conversion. Thus, by accepting the Examiner's new position, that Bibby is not relied upon to show pixel conversion, the limitation of claim 7 is not alleged to be present in any of the prior art relied upon by the Examiner.

Each element of a claim must be taught or suggested in the prior art to make a *prima facie* case of obviousness. Therefore, because the Examiner has not alleged that any other reference teaches pixel conversion, the Examiner has failed to make a *prima facie* case of obviousness. Accordingly, claim 7 is patentable over the prior art.

4. O'Boyle Does Not Teach Pixel Conversion.

Alternatively, the Examiner may have intended to allege that O'Boyle inherently disclosed pixel conversion. The unstated ground for rejection would thus be that O'Boyle teaches conversion of images, those images include pixels, therefore O'Boyle inherently teaches pixel conversion. However, O'Boyle does not teach converting

images to layer thickness.

O'Boyle clearly states that "the pixel values corresponding to the target locations are stored in succession to create an interference spectrum." (O'Boyle at column 4, line 66 – column 5, line 1). Thus, a number of images are taken of a target location and those images are converted into an interference spectrum. It is the spectrum that is subsequently equated to a thickness. (Id. at column 5, lines 1-4).

Claim 7 recites the conversion of pixels to layer thickness. An interference spectrum is not a pixel. Therefore, in addition to the reasons set forth in the Brief, claim 7 is patentable over the prior art for at least the reason set forth above.

5. Conclusion

Therefore, claim 7 is patentable over the prior art as discussed in the Brief and for at least the reasons set forth above.

*Discussion re Claim 8*

1. Claim 8

Claim 8 recites a step wherein layer thickness determination is performed *in situ*. Originally, the Examiner equated "in situ" with "in process" and alleged that O'Boyle taught *in situ* imaging because the imaging of O'Boyle was done "in process". (See Second Office Action at page 3). The Examiner now proffers an alternative argument wherein "*in situ*" is interpreted as "in a CMP assembly", as is discussed below. However, the Examiner's new construction of the "*in situ*" limitation of claim 8 is flawed.

Specifically, the Examiner's latest construction is based on the teaching of O'Boyle, not on the language of claim 8 or the specification of the present invention. The Examiner argues that the imaging of O'Boyle is "*in situ*" because it is performed "without taking the wafer out ... and putting the wafer back into the CMP process or assembly". (Answer at page 5). Thus, the Examiner appears to argue that if O'Boyle were to include a claim to imaging performed "*in situ*", the claim may be interpreted to mean "imaging performed in the CMP process or assembly". However, such an approach is relevant only if the term "*in situ*" is a term of art, and O'Boyle was relied upon to show the understanding of the term "*in situ*" of those of ordinary skill in the art. The Examiner has failed, however, to provide any such basis for his construction of the language of claim 8 based upon the specification of O'Boyle. Accordingly, it is improper to rely upon O'Boyle in interpreting the "*in situ*" language in the present claims.

Construction of the "*in situ*" claim term should be done by reference to the language of the claim and the claim's specification. (See e.g. MPEP § 2111). In the context of the present application, the specification identifies the imager unit 26 as an "in situ image acquisition unit". (Specification at page 9). The specification makes clear that while the in situ image acquisition unit may be located at various positions, all of those positions provide a view of the substrate in the area proximate the polishing pad. (See e.g. Id at pages 9-10).

Thus, the term "*in situ*" in claim 8 can be construed to mean that the imaging step is done in the area proximate the polishing pad. O'Boyle teaches imaging performed within the rinse tank. The polishing pad of O'Boyle is not disclosed as being within the rinse tank. Accordingly, O'Boyle does not teach "*in situ*" imaging as claimed.

Therefore, in addition to the reasons set forth in the Brief, claim 8 is patentable over the prior art for at least the reason set forth above.

*Discussion re Claim 9*

The Examiner applied the new rejections discussed above with respect to claims 1 and 8 to claim 9. The discussion of the Examiner's new rejections set forth above with respect to claims 1 and 8 apply equally to claim 9. Therefore, for at least the same reasons set forth above with respect to claims 1 and 8, the Examiner's new rejections of claim 7 must fail.

*Discussion re Claim 15*

1. The Discussion of Claim 1 Applies to Claim 15.

In the Answer, the Examiner applied the new rejections discussed above with respect to claim 1 to claim 15. Claim 15 is a method claim that recites steps which use limitations such as those discussed above with respect to claim 1. Therefore, for at least the same reasons set forth above with respect to claim 1, the Examiner's new rejections of claim 15 must fail.

2. The New Allegation Regarding Motivation to Combine Must Fail.

In the Brief, the Applicant argued that there was no motivation to combine O'Boyle and Bibby because the proposed modification would change a principle of operation of the references. The Examiner has not contested the Applicant's position that the proposed combination would change a principle of operation of the references.

Rather, the Examiner has offered a proposed motivation based either upon a circular argument or upon an incorrect application of the MPEP. In either event, the Examiner's approach is incorrect.

A. The Examiner's Argument to Show Motivation is a Circular Argument.

According to one reading of the Answer, the Examiner has relied upon a circular argument to show motivation to combine O'Boyle and Bibby. Specifically, the Examiner stated the following:

> The two references are analogous because they are solving similar problem of CMP. Therefore, one ordinary skilled in the art at the time of invention can simply combine the two i.e. the teachings of stopping the method one the thickness of the wafer is at the predetermined value can be incorporated in to the O'Boyle system of CMP. The motivation of [combining the references] will be determining when an end point has reached (see Bibby col. 2, lines 63-68).

(Answer at page 6).

The Answer thus may be read to mean that one would be motivated to modify O'Boyle to include the end point determination teachings of Bibby, in order to determine the end point. The Examiner has failed, however, to articulate any suggestion in O'Boyle or Bibby to include the end point determination teachings of Bibby in the system of O'Boyle. Furthermore, the Examiner has not articulated any benefit that would result from using the system of O'Boyle while determining an end point as taught by Bibby. Rather, the Examiner has simply stated that one would be motivated to combine "A" with "B" in order to have "A" and "B". Therefore, the Examiner's argument is circular and fails to identify any legally sufficient motivation to combine the references.

Because the Examiner has failed to identify any motivation in the prior art to combine the references, then, in addition to the reasons set forth in the Brief, there is no motivation to combine O'Boyle and Bibby. Accordingly, claim 15 is patentable over the

prior art as further discussed in the Brief.

B. Alternatively, The Examiner Has Improperly Applied the Law

The Examiner's new argument is susceptible to an alternative reading. However, such an alternative reading results in a position that is contrary to the law and contrary to a proper reading of the MPEP.

Specifically, in response to the Applicant's argument that the proposed combination results in a changed principle of operation, the Examiner states that "[t]he two references are analogous because they are solving similar problem of CMP. Therefore, one ordinary skilled in the art at the time of invention can simply combine the two..." (Answer at page 6). Thus, the Examiner's position is that because the prior art is analogous, the prior art can be combined even if there is a change in the principle of operation.

The Examiner's argument is apparently based upon language in MPEP § 2143.01. Therein it is noted that motivation to combine prior art references can be based upon "the nature of the problem to be solved" citing to *Ruiz v. A.B. Chance Co.*, 60 USPQ2d 1686 (Fed. Cir. 2004). This statement thus appears to contradict the precept set forth in MPEP § 2143.01 that "the proposed modification cannot change the principle of operation of a reference" citing to *In re Ratti*, 270 F.2d 810 (CCPA, 1959). However, the apparent contradiction, and the Examiner's contention, is easily dismissed.

1) *In re Ratti* Is Not Limited to Non-analogous Art

As an initial matter, there is no language limiting the principle of *In re Ratti* to non-analogous art. Accordingly, the principle of *In re Ratti* is properly applied to the

proposed combination of O'Boyle and Bibby.

As set forth above, the Examiner has not contested the Applicant's position that the proposed combination of O'Boyle and Bibby requires a change in the principle of operation of the prior art. Therefore, under *In re Ratti*, such a combination is improper.

2) *Ruiz* Cannot Modify *In re Ratti*

The "nature of the problem" guidance is based upon a panel decision of the Federal Circuit that issued in 2004, *Ruiz v. A.B. Chance Co.*, 60 USPQ2d 1686 (Fed. Cir. 2004). However, the "principle of operation" guidance is based upon a case from 1959, *In re Ratti*, 270 F.2d 810 (CCPA, 1959). Under Federal Circuit practice, the *Ruiz* panel cannot overturn the law of *In re Ratti*. Accordingly, to the extent the law of *Ruiz* and *In re Ratti* conflicts, the law of *In re Ratti* is to be followed.

Therefore, because the Examiner has not contested the argument that the proposed combination of O'Boyle and Bibby requires a change in the principle of operation of the prior art, such a combination is improper.

3) *Ruiz* and *In re Ratti* Do Not Conflict

Moreover, the *Ruiz* case should be read in a manner that is consistent with *In re Ratti* if possible. Unsurprisingly, the *Ruiz* case can in fact be read so as not to conflict with *In re Ratti*.

Specifically, the lower court in the *Ruiz* case had found that the teachings of the two references in that case could actually be combined in either of two ways, and then discussed the motivation for combining the references. (*Ruiz*, 60 USPQ2d at 1689). In other words, *Ruiz* did not involve a change in the principle of operation. Instead, only after it established the technical feasibility of the combination did the court look for

motivation based upon the nature of the problem to be solved.

The Federal Circuit upheld the ruling of the lower court. The panel of the Federal Circuit then noted the following.

> Stated differently, this court has consistently stated that a court or examiner *may* find a motivation to combine prior art references in the nature of the problem to be solved. See Pro-Mold, 75 F.3d at 1573; Display Techs., Inc. v. Paul Flum Ideas, Inc., 282 F.3d 1340, 1346-47 (Fed. Cir. 2002); In re Huang, 100 F.3d 135, 139 n.5 (Fed. Cir. 1996). This form of motivation to combine evidence is particularly relevant with simpler mechanical technologies.

(Id. at 1690)(emphasis added).

The above quotation is susceptible to two different interpretations. According to one interpretation, regardless of the particular teachings involved, motivation to combine prior art references is provided by the similar nature of the problem to be solved. According to a second interpretation, only in some circumstances is motivation to combine prior art references provided by the similar nature of the problem to be solved.

Because the first interpretation places *Ruiz* in direct conflict with *In re Ratti*, while the second interpretation allows *Ruiz* and *In re Ratti* to not conflict with each other, the proper reading is the second interpretation. Therefore, one circumstance in which motivation to combine the prior art cannot be provided by the similar nature of the problem to be solved, is a circumstance wherein the proposed combination requires a change in the principle of operation of the prior art. For similar reasons, the MPEP should be read in a similar fashion.

Accordingly, because the Examiner has failed to point to any source of motivation to combine O'Boyle and Bibby other than motivation based upon solving a similar problem, and because the Examiner has not contested the argument that the proposed combination of O'Boyle and Bibby requires a change in the principle of operation of the

prior art, such a combination is improper.

4) Conclusion

The Examiner's argument regarding the motivation to combine O'Boyle and Bibby is either circular or based upon an improper application of the law and an improper reading of the MPEP. In any event, the argument is flawed, and there is no motivation to combine O'Boyle and Bibby because such a combination requires a change in the principle of operation of the prior art. Therefore, the proposed combination is improper. Accordingly, claim 15 is patentable over the prior art as is further discussed in the Brief.

*Discussion re Claims 23-28*

In the Answer, the Examiner applied the new rejections discussed above with respect to claim 15 to claims 23-28. Claims 23-28 include limitations similar to those discussed above with respect to claim 15. Therefore, for at least the same reasons set forth above with respect to claim 15, the Examiner's new rejections of claims 23-28 must fail.

*Discussion re Claim 21*

In the Answer, the Examiner applied the new rejections discussed above with respect to claim 15 to claim 21. Claim 21 depends from claim 15. Therefore, for at least the same reasons set forth above with respect to claim 15, the Examiner's new rejection of claim 21 must fail.

In the Answer, the Examiner also changed the rejection of claim 21 in the same way that the rejection of claim 7 was changed. Therefore, for at least the same reasons

set forth above with respect to claim 7, the Examiner's new rejection of claim 21 must fail.

*Discussion re Claim 22*

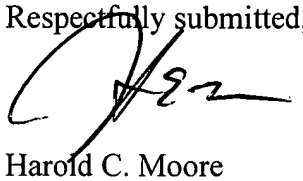
In the Answer, the Examiner applied the new rejections discussed above with respect to claim 15 to claim 22. Claim 21 depends from claim 15. Therefore, for at least the same reasons set forth above with respect to claim 15, the Examiner's new rejection of claim 22 must fail.

In the Answer, the Examiner also changed the rejection of claim 22 in the same way that the rejection of claim 8 was changed. Therefore, for at least the same reasons set forth above with respect to claim 8, the Examiner's new rejection of claim 22 must fail.

**Conclusion**

The Examiner's Answer introduces a number of new grounds for rejection. However, for the reasons set forth above, the new grounds are not valid. Thus, for all of the foregoing reasons and/or the reasons set forth in the Brief, claims 1-28 are not unpatentable under 35 U.S.C. § 103(a). As a consequence, the Board of Appeals is respectfully requested to strike the Answer and to reverse the rejection of these claims.

Respectfully submitted,



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